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Development of the National Food System through Digitalization and Downstreaming to Strengthen National Food Security

Muhammad Adymas Hikal Fikri [a] ✉, Yustina Dhian Novita [a], Moh. Imam Gusthomi [a]

[a] Faculty of Law, Universitas Negeri Semarang, Indonesia

✉ Corresponding email: Hikal@mail.unnes.ac.id

Abstract

Geopolitical tensions in countries have triggered uncertainty in global financial, resulting in inflationary which could to global energy and food crisis, including for Indonesia. This condition must addressed with appropriate policies , one of which is the development of a digitalization and agricultural downstream system. This article used the qualitative description method, the objective of the article is presented in comprehensive manner regarding the overview of food security in Indonesia, urgency and implementation digitalization and downstream-agriculture. In-2022, Indonesia's food security index will experience decline from the previous year. This decrease was caused mainly due to decrease in food quality and safety scores.The agricultural digitalization

and downstream system allows Indonesian agriculture to be further developed so that farmers gain understanding of the required land use, but the results are satisfactory and the costs are more efficient. Agricultural digitalization interpreted as changing way things are done in aspects of agriculture, from processing to marketing.Meanwhile, downstreaming is carried out by developing agricultural activities to strengthen product processing processes, as well as developing technology in processing industry sector by strengthening the bargaining position of agricultural-based processed products. Digitalization and downstreaming can implemented through digitalization upstream and downstream from production, post-harvest, warehousing, processing, marketing and financing in the food sector through optimizing the role of MSMEs. This is realized by preparing business model digital farming through distribution smart green houseto MSMEs, distribution smart farming to food clusters, distribution of post-harvest processing machines, digitalization of product marketing with start up agriculture, to market digitalization.

KEYWORDS *Geopolitics, Agriculture, Food Security, Digitalization, Downstreaming*

Introduction

The world is facing a new threat, namely the food crisis. The increase in energy prices that occurred as the world economy boomed caused food prices to also rise. This is now also being made worse by the conflict or war between Russia and Ukraine. The current world geopolitical conditions are also having an impact on the Indonesian food sector. The aspect of availability and affordability of food is considered to be the most important in order to meet domestic needs. Until now, Indonesia has been quite lucky because the price of rice, which is the people's main food ingredient, has not experienced an increase in prices,

both at the national and international levels. However, this must not make the defense to face the threat of a food crisis weak.[1]

Geopolitics is an important factor that influences the macroeconomic conditions of a country, including Indonesia. Conditions or events experienced by one country will influence other countries through the transmission of export and import activities.[2] A more unexpected impact on price pressure would be if rational expectations theory occurred in the case of the Russian-Ukrainian war. This theory explains that if economic actors or the entire community know the impact that will arise from a policy or event that is occurring, they will provide a massive response that can be uncontrollable.[3]

Geopolitical tensions followed by the implementation of protectionist policies in a number of countries are considered capable of triggering global financial market uncertainty due to disruption of supply chains, resulting in increasingly deep inflationary pressures. This condition will also cause commodity prices to soar which could lead to a global energy and food crisis, including for Indonesia.

Other visible impacts of geopolitics are the sharpest slowdown in economic activity, increasing inflation, accelerating food crises, wider geopolitical conflicts, and worsening poverty.[4] According to ICDX Research & Development Girta Yoga,Throughout the third quarter of 2022, Indonesian food prices and inflation experienced an increase. Food prices rose by 12.14 *year of year* (yoy) and Indonesian inflation rose by 230.79 percent yoy. Indonesia has indeed benefited from rising commodity prices. However, the Central Statistics Agency (BPS) stated

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1 Kharel, Menila, Bed Mani Dahal, and Nani Raut. "Good agriculture practices for safe food and sustainable agriculture in Nepal: A review." *Journal of Agriculture and Food Research* 10 (2022): 100447.

2 Anggoro, Kusnanto. "Perubahan Geopolitik dan Ketahanan Nasional: Sebuah Penjelajahan Teoretikal." *Jurnal Lemhannas RI* 5.1 (2017): 5-17.

3 Elizabeth, Roosganda, and Iwan Setiajie Anugrah. "Akselerasi hilirisasi produk agroindustri berdayasaing mendongkrak kesejahteraan petani dan ekonomi pedesaan." *Jurnal Mimbar Agribisnis* 6.2 (2020): 890-918.

4 Cohen, Saul Bernard. *Geopolitics: The Geography of International Relations*. Rowman & Littlefield Publishers, 2021.

that the prices of several commodities at the global level were lower than in the last few months.

Global economic performance is showing fluctuations due to the impact of The Perfect Storm which has triggered an increased risk of stagflation and recession in various countries around the world. These global dynamics will also have an impact on the stability of the national economy, so strengthening and calculations related to efforts to strengthen the performance of various economic sectors need to be carried out.[5] Understanding the dynamics of Indonesia's role in the world economic and political constellation, guarantees are needed so that national economic recovery efforts, guaranteeing food and energy security, can be carried out well. The existence of the Russia-Ukraine conflict has resulted in increasing threats to the vital sectors of each country, including the national food sector.[6] This condition must be addressed with the right policies and steps from Indonesia which is in world geopolitics, so that it requires continuing to increase Indonesia's commitment to the principles of non-alignment in responding to current world political and economic changes. The changing world political conditions require the nation's children to work together to strengthen food security.

One sector that has a big influence on food security in Indonesia is the agricultural sector. Indonesia is a country where the majority of the population makes their living as farmers. According to BPS (2021), the number of agricultural households has even reached 27.68 million farming households which are divided into several subsectors ranging from rice, secondary crops, horticulture, plantations, forestry, animal husbandry to fish cultivation. Indonesia is an agricultural country which has consequences for the growth of the lives of almost all Indonesian people, so the government needs to pay attention to a strong and resilient agricultural sector. Therefore, one of the sectors that supports economic growth is the agricultural sector. This means that farmers play a very important role in the entire Indonesian national economy.

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[5] Elizabeth & Anugrah, "Akselerasi Hilirisasi Produk Agroindustri Berdayasaing Mendongkrak Kesejahteraan Petani dan Ekonomi Pedesaan."

[6] Chiles, Robert M., et al. "Democratizing ownership and participation in the 4th Industrial Revolution: challenges and opportunities in cellular agriculture." *Agriculture and Human Values* 38.4 (2021): 943-961.

According to the World Food Program report, one in every nine Earth's population, namely 805 million people, lacks food for a healthy and active life. With expected population growth to more than 9 billion people in the next 30 years. In the future, the amount of food production must be increased by another 70 percent. Otherwise, society the world will be even more hungry.[7] In the current era of disruption of the Industrial Revolution 5.0, increasing agricultural productivity is possible to do. Artificial intelligence (artificial intelligence), Robotics, the Internet of Things (IoT) can increase productivity and improve quality life in many ways. This disruption can inspire people to do more in agriculture home. Going forward, it seems highly likely that we will see more interest in agriculture for investment, career and national security than has been the case in a long time.[8]

Prof. Zun, an agricultural researcher at a Venezuelan university and also a UN label holder, said that the agricultural sector would definitely be crushed if there was no high level of attention from the government in an agricultural country. If at that point there is a disaster, then we will realize how important the food produced by the agricultural sector is. Therefore, the development of the agricultural sector should not be forgotten, in fact it really needs the government's attention and focus.[9] In fact, Indonesia can become a developed country, even though it must be based on agriculture. If this can be done, then there will come a time when all the countries around Indonesia will be very dependent for their food from this mother earth. New Zealand, Vietnam and other countries are examples of countries whose economic development is based on agriculture.

According to Malta, research results show that the factors that are important to consider to increase farmer resilience in making decisions for

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[7] MacPherson, Joseph, et al. "Future agricultural systems and the role of digitalization for achieving sustainability goals. A review." *Agronomy for Sustainable Development* 42.4 (2022): 70.

[8] Kuntke, Franz, et al. "Resilience in agriculture: communication and energy infrastructure dependencies of German farmers." *International Journal of Disaster Risk Science* 13.2 (2022): 214-229.

[9] Bhagat, Priya Rani, Farheen Naz, and Robert Magda. "Artificial intelligence solutions enabling sustainable agriculture: A bibliometric analysis." *PloS one* 17.6 (2022): e0268989.

farming success are: active search for information related to farming and interaction with extension workers.[10] These factors reflect the greater need to accelerate agriculture production in Indonesia with the potential to reduce imports of major food items such as grains and vegetables, eventually leading to improved food security and poverty reduction in the country.[11]

The changing world political conditions require the nation's children to work together to strengthen food security. Optimism to strengthen food security must continue to be built through the implementation of strategic steps to be able to accelerate this achievement. To anticipate the impact and reduce the impact in various sectors of geopolitical dynamics both directly and indirectly on Indonesia, the Government needs to make various policy navigation efforts, especially in facing challenges and uncertainty resulting from the global crisis in the energy and food sectors.

The government has taken various strategic steps to face the challenges and uncertainty resulting from the global crisis in the energy and food sectors. One of them is to create two superior programs to support national resilience, namely digitalization and agricultural downstreaming. These two strategies are considered to be synergy and innovation to maintain national food security, as well as a commitment to strengthening food inflation control, including ensuring controlled inflation through the national movement to control food inflation. This movement is to build synergy, encourage production, downstreaming and food security by digitalizing the economy.

The program favored by the government is a big program, but can this program be implemented and run well in Indonesia? From this background, a study was carried out which aims to find out what the urgency of the digitalization and downstream food system program in Indonesia is for national food security and how the real implementation

[10] Malta, Malta. "Faktor-faktor yang Berhubungan dengan Kemandirian Petani dalam Pengambilan Keputusan untuk Keberlanjutan Usahatani (Kasus Petani di Desa Sukaharja-Kabupaten Bogor)." *Cakrawala-Jurnal Humaniora* 16.1 (2016).

[11] Béné, Christophe, et al. "Contribution of fisheries and aquaculture to food security and poverty reduction: assessing the current evidence." *World development* 79 (2016): 177-196.

of these two programs can be carried out well and in accordance with targets by looking at the state of food security in Indonesia in the future. recently.

This article is part of the results of a study based on a survey to collect various data and information related to research objectives. Using the qualitative description method, the aim of the article is to comprehensively explain the picture of food security in Indonesia, the urgency of digitizing and downstreaming the food system in Indonesia towards national food security and the real implementation of these two programs.

The data used in this research is secondary data. The main data used are the 2022 food security index data published by the National Food Agency and the 2022 food security analysis published by the Agricultural Data and Information Systems Center of the Ministry of Agriculture. Apart from that, the supporting data used includes related journals and books as well as Indonesian statistical data from the Central Statistics Agency.

Overview of Food Security in Indonesia

Food is a basic human need that must be met at all times. The right to obtain food is a human right, as stated in article 27 of the 1945 Constitution and in the Rome Declaration (1996). These considerations underlie the issuance of Law No. 7 of 1996 concerning Food. As a basic need and a human right, food has a very important meaning and role in the life of a nation. Food availability that is less than needed can create economic instability. Various social and political upheavals can also occur if food security is disrupted. This critical food condition can even endanger economic stability and national stability.[12]

For Indonesia, food is often identified with rice because this type of food is the main staple food. Experience has proven to us that disruptions to food security, such as the skyrocketing increase in rice prices during the 1997/1998 economic crisis, which developed into a multidimensional

[12] Nasirahmadi, Abozar, and Oliver Hensel. "Toward the next generation of digitalization in agriculture based on digital twin paradigm." *Sensors* 22.2 (2022): 498.

crisis, have triggered social insecurity that endangers economic stability and national stability.

Considering the importance of rice, the Government always strives to increase food security, especially from increasing domestic production. These considerations become increasingly important for Indonesia because its population is increasingly large with a wide population distribution and geographical coverage. To meet the food needs of its population, Indonesia requires the availability of food in sufficient and distributed quantities, which meets consumption adequacy and sufficient national stock according to the operational requirements of extensive and distributed logistics. Indonesia must maintain its food security.[13]

The definition of food security cannot be separated from Law no. 18/2012 concerning Food. It is stated in the Law that Food Security is "*the condition of food fulfillment for the state and individuals, which is reflected in the availability of sufficient food, both in quantity and quality, safe, diverse, nutritious, equitable and affordable and does not conflict with religion, belief and community culture, to be able to live healthy, active and productive lives in a sustainable manner.*" National food security is still an important issue for Indonesia considering that adequate food production, distribution and consumption has dimensions that are related to social, economic and political dimensions. Food security is an integrated system consisting of various subsystems. The main subsystems include food availability, food affordability, as well as food quality and safety. The realization of food security is a synergy of the interaction of these three sub-systems.[14]

A country's level of food security can be seen from several indicators. Based on the 2022 rice balance prognosis, which was updated as of August 2022. The estimate for Indonesia's rice supply comes from the January-December GKG production estimate based on KSA BPS of 54.57 million tons with a total estimated rice production of 31.33 million tons. The estimated total demand for rice in 2022 is 30.77 million tons,

[13] Kutyauripo, Innocent, Munyaradzi Rushambwa, and Lyndah Chiwazi. "Artificial intelligence applications in the agrifood sectors." *Journal of Agriculture and Food Research* 11 (2023): 100502.

[14] Devi, Laksmi Yustika, et al. "Model sosial-ekonomi dan ketahanan pangan rumah tangga di Indonesia." *Jurnal Ekonomi Dan Pembangunan* 28.2 (2020): 103-115.

consisting of direct household consumption of 22.55 million tons and consumption outside the household of 8.21 million tons. So in 2022 it is estimated that there will be a surplus of 555.91 thousand tonnes, with stocks at the end of December 2021 amounting to 5.27 million tonnes so that the cumulative rice balance until December 2022 will be 5.83 million tonnes.[15]

TABLE 1. Realization and Prognosis of the Balance of Rice Supply and Needs, January - December 2022

Bulan	Prakiraan Produksi GKG (Ton)	Prakiraan Produksi Beras (Ton)	Perkiraan Kebutuhan Beras (Ton)			Prakiraan Neraca Bulanan (Produksi-Kebutuhan) (Ton)	Prakiraan Neraca Kumulatif (Surplus/ Defisit) (Ton)
			Konsumsi Luar RT	Konsumsi Langsung RT	Total		
Stok Akhir Desember 2021							**5.272.537**
Jan-22	2.416.360	1.391.690	1.824.082	664.277	2.488.358	-1.096.668	4.175.869
Feb-22	4.037.138	2.323.760	1.647.558	599.992	2.247.549	76.211	4.252.079
Mar-22	9.389.825	5.407.525	1.844.866	671.846	2.516.712	2.890.813	7.142.892
Apr-22	7.559.044	4.353.104	2.645.801	963.522	3.609.324	743.780	7.886.673
Mai-22	4.033.439	2.326.304	1.962.644	714.737	2.677.380	-351.076	7.535.596
Jun-22	4.360.281	2.512.107	1.765.240	642.848	2.408.089	104.018	7.639.615
Jul-22	4.722.061	2.720.541	1.841.402	670.584	2.511.986	208.554	7.848.169
Agts-22	4.724.939	2.722.199	1.824.082	664.277	2.488.358	233.841	8.082.010
Sep-22	3.839.312	2.211.959	1.765.240	642.848	2.408.089	-196.130	7.885.880
Okt-22	4.738.318	2.729.907	1.824.082	664.277	2.488.358	241.549	8.127.428
Nov-22	2.943.334	1.629.150	1.765.240	642.848	2.408.089	-778.939	7.348.490
Des-22	1.808.095	1.000.676	1.844.866	671.846	2.516.712	-1.516.036	5.832.454
Total 2022	**54.572.146**	**31.328.921**	**22.555.104**	**8.213.900**	**30.769.004**	**559.917**	

Sumber : Relisasi dan prognosa Pangan Strategis, Ditjen Tanaman Pangan update per Agustus 2022
Keterangan : 1. Stok akhir Des 2021 berdasarkan SNANK.
2. Produksi GKG Jan-Okt berdasarkan data KSA BPS posisi Ags 2022, Nov-Des berdasarkan Rata2 3 tahun bulan yang sama
3. Kebutuhan beras 111,799 kg/kap/th terdiri dari konsumsi langsung RT (beras dan ketan) sebesar 81,83 kg/kap/th, Susenas Tri I 2021 dan konsumsi di luar rumah tangga 29,97 kg/kap/th (Survei Bapok 2017)
4. Jumlah penduduk tahun 2022 sebanyak 275.773.774 jiwa (Proyeksi Penduduk Indonesia Interim (Juni) , SP 2020, BPS).
5. Koefisien kebutuhan HBKN tahun 2022 berdasarkan harian (Bapanas, 2022).

Even though the estimated monthly balance for rice in 2022 looks like a surplus, there are months that experience a deficit, namely January, May, September, November to December and other months have a surplus.

Based on the results of the 2022 IKP calculation from nine indicators for district areas and eight indicators for city areas which reflect three aspects of food security, it provides an overview of the ranking of a region's food security achievements compared to other regions. The IKP produced in each region is grouped into six groups based on the IKP cut

[15] Sehusman, Sehusman, et.al. *Analisis Ketahanan Pangan Tahun 2022*. Pusat Data dan Sistem Informasi Pertanian Kementerian Pertanian, 2022.

off point. Regions that fall into group 1 are districts/cities that tend to have a higher level of vulnerability than districts/cities in the group above, whereas regions in group 6 are districts/cities that have the best food security.[16]

A total of 70 districts or 16.83 percent of 416 districts had low IKP scores with the following distribution: 25 Priority 1 districts; 16 Priority 2 districts; and 29 Priority 3 districts. Priority 1 districts (very vulnerable) are spread across Papua Province (19 districts) and West Papua (6 districts). Meanwhile, in the city area there are 4 cities (4 percent) out of 98 cities that have low IKP scores, consisting of Subulussalam City, Aceh Province (Priority 1); and Gunung Sitoli City, North Sumatra Province; Pagar Alam City, South Sumatra Province; and Tual City, Maluku Province (Priority 3).[17]

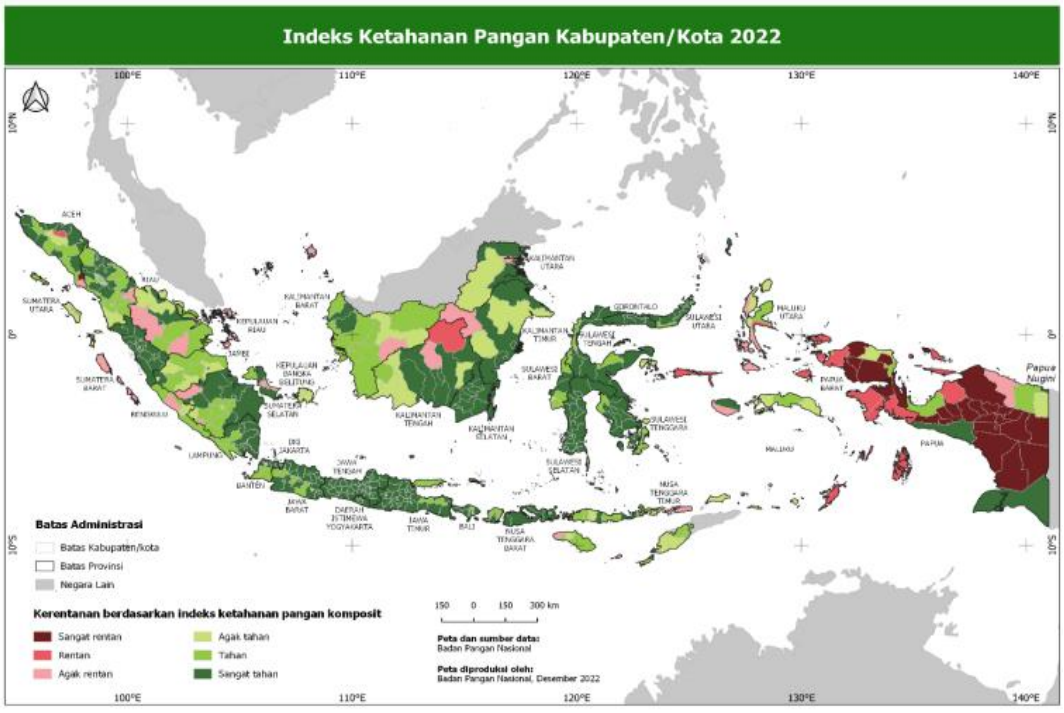

FIGURE 1. Regency/City Food Security Index in Indonesia 2022

[16] Tono, Tono, Dian Wuri Andayani, Anwar Hidayat, Lintang Dewi Maheswari, & Nabila Ayu Ulfa. *Indeks Ketahanan Pangan Tahun 2022.* Badan Pangan Nasional, 2022.

[17] Tono, et.al.

Based on the Regency IKP ranking, the five districts with the best scores are Tabanan (92.20), Badung (91.29) and Gianyar (91.07) in Bali Province; Sukoharjo (89.11) and Wonogiri (88.15) in Central Java Province. Meanwhile, the five districts with the lowest scores are in Papua Province, namely Nduga (15.66), Intan Jaya (17.21), Central Mamberamo (18.14), Puncak (18.27), and Lanny Jaya (19.18). Meanwhile, based on the City IKP ranking, the five cities with the best scores are Denpasar (91.82), Balikpapan (89.47), Salatiga (87.39), Semarang (87.13), and Bekasi (86.79). Meanwhile, the five cities with the lowest scores were Subulussalam (23.93), Gunungsitoli (43.70), Tual (45.18), Pagar Alam (46.76) and Tanjung Balai (53.17).

Globally, the food security index of countries in the world is presented in the Global Food Security Index (GFSI) figures. The food security index consists of four indicators, namely food availability, affordability of food access, food quality and safety, and sustainability and adaptation. During 2018-2022, the best ranking for Indonesia's food security index based on GFSI was in 2018. In that year, Indonesia was ranked 58th among 113 countries in the world with a food security index score of 63.6. However, in 2022, Indonesia's ranking will decline to 63rd with the food security index score also decreasing to 60.2. The downgrade in ranking in 2022 was caused by a decline in three food security index indicators.[18]

The food quality and safety ranking decreased seven points to 78th with a score of 56.2. The next indicator which also decreased quite significantly was food availability, the score in 2022 was 50.9, down compared to 2021 which was 57.0 or in terms of ranking down from 61st to 84th. One of the reasons for this decrease was the Russian-Ukrainian war which caused an increase in prices. food and the existence of political barriers which then affect the availability of food.[19] In detail, the ranking

[18] Sehusman, et.al. *Analisis Ketahanan Pangan Tahun 2022*.

[19] Sehusman, et.al. Furthermore, it is emphasized that food security analysis for Indonesia in 2022 reveals a landscape marked by a blend of stability and vulnerability across various key dimensions. Throughout the year, Indonesia maintained a steady production output for staple crops such as rice, corn, and soybeans, underscoring the nation's agricultural resilience. However, this stability was not uniform across all crops, as localized challenges such as adverse weather

and score of Indonesia's food security index based on the Global Food Security Index for 2018 to 2022 can be seen in Table 2.

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conditions, pests, or diseases may have affected specific agricultural sectors. In tandem with domestic production, Indonesia continued to rely on imports to meet the demand for essential commodities like wheat and sugar. While such reliance ensures consistent food availability, it also exposes the nation to fluctuations in global markets and trade dynamics. Government policies, including subsidies for farmers and investment in agricultural infrastructure, played a pivotal role in bolstering food security efforts, contributing to stability in both production and prices. Looking ahead to 2023, the food security landscape may have undergone shifts in response to evolving external factors and internal developments. Global economic conditions, trade agreements, and geopolitical events could have influenced Indonesia's import-export dynamics, potentially altering the balance of self-sufficiency and dependency in the food supply chain. Moreover, advancements in agricultural technology and changes in government policies may have shaped the trajectory of domestic production and resilience against environmental challenges. Environmental factors, including climate change and land degradation, pose ongoing threats to Indonesia's food security. Addressing these challenges requires concerted efforts to promote sustainable agricultural practices, mitigate environmental risks, and enhance the resilience of rural communities. Analyzing the trends and changes in food security from 2022 to 2023 provides valuable insights for policymakers, researchers, and practitioners to devise informed strategies aimed at ensuring the long-term food security and well-being of Indonesia's population. *See also* Timmer, Peter. "Food security in Indonesia: current challenges and the long-run outlook." *Center for Global Development Working Paper* 48 (2004); Duffy, Colm, et al. "Agroforestry contributions to smallholder farmer food security in Indonesia." *Agroforestry Systems* 95.6 (2021): 1109-1124; Neilson, Jeff, and Josephine Wright. "The state and food security discourses of Indonesia: Feeding the bangsa." *Geographical Research* 55.2 (2017): 131-143; Widada, Arif Wahyu, Masyhuri Masyhuri, and Jangkung Handoyo Mulyo. "Determinant factors of food security in Indonesia." *Agro Ekonomi* 28.2 (2017): 205-219; Limenta, Michelle Engel, and Sianti Candra. "Indonesian Food Security Policy." *Indonesia Law Review* 7.2 (2017): 245-265; Rusastra, I. Wayan, et al. "Food security and poverty in the era of decentralization in Indonesia." *CAPSA Documento de trabalho* 102 (2008); Amrullah, Eka Rastiyanto, et al. "Who suffers from food insecurity in Indonesia?." *International Journal of Social Economics* 46.10 (2019): 1186-1197; Syuhada, A., et al. "Food security and environmental sustainability on the South Sumatra Wetlands, Indonesia." *Systematic Reviews in Pharmacy* 11.3 (2020): 457-464.

TABLE 2. Indonesian Food Security Index Rankings and Scores based on the Global Food Security Index, 2018 – 2022

Tahun	Ketersediaan		Keterjangkauan		Kualiatas dan Keamanan		Keberlanjutan dan Adaptasi		Total	
	Peringkat	Skor	Peringkat	Skor	Peringkat	Skor	Peringkat	Skor	Peringkat	Skor
2018	55	56,5	52	80,8	71	62,8	59	49,5	58	63,6
2019	60	56,9	57	78,2	70	60,5	79	45,2	63	61,5
2020	62	57,2	43	83,3	85	53,9	80	45,5	61	61,6
2021	61	57,0	51	78,1	89	52,9	82	45,5	68	59,8
2022	84	50,9	44	81,4	78	56,2	83	46,3	63	60,2

Sumber : *Global Food Security Index*

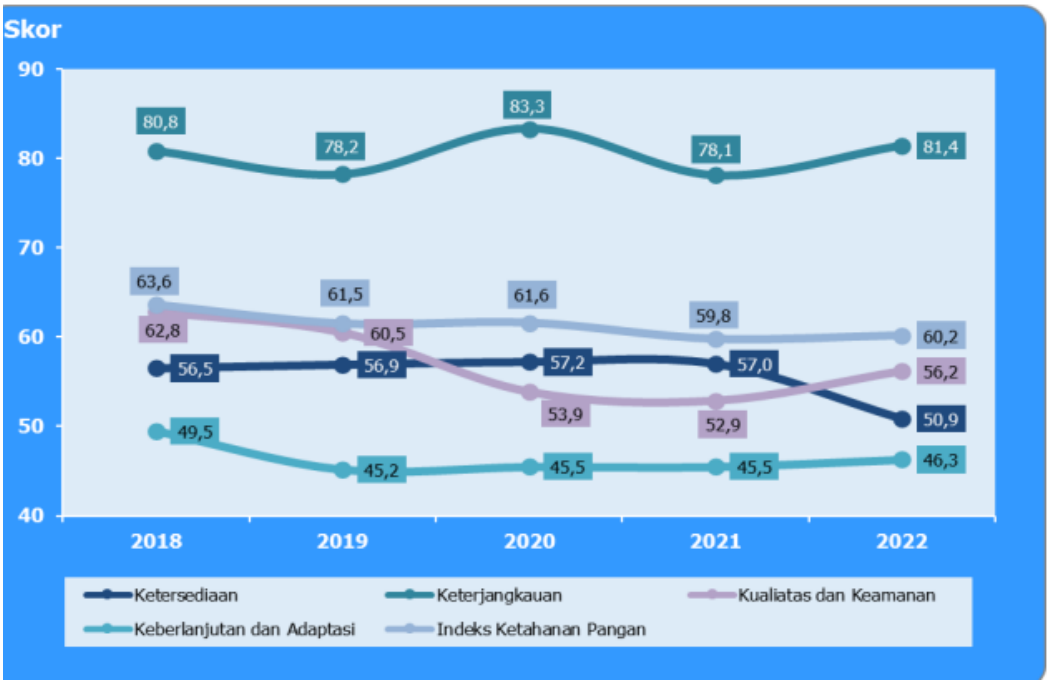

FIGURE 2 Indonesia's Food Security Index score is based on Global Food Security Index, 2018 – 2022

Furthermore, if we look at the development of the GFSI of countries in the world in 2022, Indonesia is ranked 63rd in the world with a food security index score of 60.2 and up 5 places compared to 2021.

Over the last five years, Indonesia's highest food security index score was obtained in in 2018, it was 63.6. In detail, the ranking and food security index scores of countries in the world can be seen in Table 3

TABLE 3. Food Security Index for Countries in the World (data: 2018 – 2022).

Peringkat	Negara	Indeks Ketahanan Pangan Global					Pertumbuhan 2021-2022
		2018	2019	2020	2021	2022	
1	Finlandia	83,8	83,6	84,3	82,7	83,7	↔
2	Irlandia	82,4	82,7	82,4	81,6	81,7	↔
3	Norwegia	82,3	81,7	80,9	78,4	80,5	▲5
4	Prancis	78,4	77,9	78,0	78,3	80,2	▲5
5	Belanda	80,7	80,9	79,5	79,9	80,1	▼2
6	Jepang	79,8	79,7	80,1	79,5	79,5	▼2
7	Kanada	76,1	77,8	77,6	79,5	79,1	▼3
8	Swedia	80,9	80,4	79,3	77,7	79,1	▲4
9	Inggris	76,9	78,4	78,8	79,3	78,8	▼3
10	Portugal	79,2	78,8	79,7	77,0	78,7	▲7
⋮							
63	Indonesia	63,6	61,5	61,6	59,8	60,2	▲5

Sumber : *Global Food Security Index*

Meanwhile, if you look at the Asia Pacific region, which includes 23 countries, the top ranking is Japan with a score of 79.5 in 2022. As the country with the largest food security index score in Asia Pacific, Japan is also included in the top ten countries in the world, namely ranking 1st. - 6. From 2018 to 2022, Japan maintains its ranking as the first country with strong food security in Asia Pacific. There are four countries in Southeast Asia that are ranked in the top 10 countries with the largest food security index scores in Asia Pacific, namely Singapore, Malaysia, Vietnam and including Indonesia. Indonesia is ranked 10th in 2022 with a food security index score increasing from 59.8 to 60.2. Even though Indonesia is ranked in the top ten.[20]

[20] Sehusman, et.al. *Analisis Ketahanan Pangan Tahun 2022.*

Urgency and Implementation of Agricultural Digitalization and Downstream Development in Indonesia to Strengthen National Food Security

Indonesia is an agricultural country which has consequences for the growth of the lives of almost all Indonesian people, so the government needs to pay attention to a strong and resilient agricultural sector. Therefore, one of the sectors that supports economic growth is the agricultural sector. To manage their agricultural business well, farmers need knowledge and information regarding research results, the experience of other farmers, the current situation in the market for agricultural inputs and products, and government policies. Increasing the use of telecommunications networks provides more information and communication technology capabilities to reach areas to rural areas. . This means that farmers play a very important role in the entire Indonesian national economy. This matter, shown by many people or workers in the agricultural sector. Farmers and agriculture are a large basis of the Indonesian economy. If only this agribusiness system could get attention from the government, then Indonesia could be independent in terms of providing food for the population, which could strengthen national food security.

The food security strategy must of course be based on the National Food Security Policy Direction which cannot be separated from the mandate stated in the preamble to the 1945 Constitution, fourth paragraph, namely: "*to form an Indonesian state government that protects the entire Indonesian nation and all of Indonesia's blood and to promote general welfare, educate the life of the nation, and participate in implementing world order based on independence, eternal peace and social justice.*" The main target of the national food security strategy is to achieve availability, independence, sovereignty, competitiveness and accessibility of the population to food in order to achieve a prosperous society and national resilience. Efforts to increase availability, this independence and competitiveness (*Food Self-Sufficiency*) must become a national commitment. based on a resource and knowledge-based strategy by prioritizing the agriculture, plantation and fisheries sectors in the broadest sense. Priority is not only given to on farm but also off farm, in order to

increase the added value of national food products, so that the competitiveness of national food products will increase.[21]

The increase in agricultural products must always be increased at all times because population increases all the time. An increase in population means an increase in demand or consumption of agricultural products. One effort that has been proven to be able to increase agricultural production is agricultural digitalization.[22] The application of technology is the main key to accelerating agricultural products. Technology plays a role in increasing farmers' productivity and income because technology also influences the production process. In the era of digitalization in the industrial revolution 4.0, stakeholders in the agricultural sector must be able to prepare and adapt to these changes. One of the keys to this change is the use of the internet by farmers. One indicator to see how far agricultural digitalization efforts have been carried out is to see how many farmers use the interne.[23]

Digitalization and downstream agriculture is one of the strategies for strengthening national food security, where this concept is relatively new in Indonesia. This concept allows Indonesian agriculture to be further developed using the latest technology in the Industrial Revolution 5.0 era so that the production process is more efficient. Not only is it economically beneficial to overcome the food crisis, but agricultural digitalization is also expected to have an impact on society. For example, giving birth to the next generation who are ready to move into the field of modern agriculture to create new jobs. Agricultural digitalization is a necessity in developing agriculture today because the need for food is increasing while agricultural land is shrinking. Based on BPS data 2021, the area of agricultural land in

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[21] Miyasto, Miyasto. "Strategi Ketahanan Pangan Nasional guna Meningkatkan Kemandirian dan Daya Saing Ekonomi dalam Rangka Ketahanan Nasional." *Jurnal Lemhannas RI* 2.1 (2014): 17-34.

[22] Wang, Yan, Lingling Zuo, and Shujing Qian. "Green-biased technical change and its influencing factors of agriculture industry: empirical evidence at the provincial level in China." *International Journal of Environmental Research and Public Health* 19.23 (2022): 16369.

[23] Sgroi, Filippo. "Evaluating of the sustainability of complex rural ecosystems during the transition from agricultural villages to tourist destinations and modern agri-food systems." *Journal of Agriculture and Food Research* 9 (2022): 100330.

2013 reached 7, 75 million ha experienced a shrinkage of 0.65 million ha so that in 2018 it became 7.1 million ha. Thus, it can be concluded that digitalization and agricultural downstreaming have the potential to change farmers' mindsets in order to maximize and utilize this digital era as best as possible, so as to encourage farmer independence.

Kai et al explained that farmers do not get the biggest percentage of profits, in fact the biggest profits are made by traders, while farmers get the biggest profits if farmers sell their products to consumers directly. It can be concluded that digitalization and agricultural downstreaming have the potential to change farmers' mindsets in order to maximize and utilize this digital era as best as possible, so as to encourage farmer independence.[24]

Literally, the meaning of digitalization is a change from conventional (analog) methods to a digital system in the form of text, numbers, audio and visuals. In other words, digitalization of the agricultural system is a breakthrough regarding agricultural information in one platform (container). Digitalization is here to facilitate human activities. The emergence of digitalization also provides opportunities to bring innovation to the agricultural sector. It is hoped that the presence of innovation will provide benefits to ease farmers' work and increase productivity. The ease of internet access which is part of digitalization can also help farmers. Farmers can use the internet to see weather forecasts. Weather is a very crucial component in determining the success of a farmer. For example, if the weather forecast is very hot, then farmers need to irrigate so that the plants do not wither. Apart from that, with easy internet access, farmers can search for information about pests and diseases in plants. So handling will be easier and prevent crop failure.[25]

Digitalization can also facilitate the process of distributing harvests. Farmers can market their own crops in order to obtain maximum results. There is one factor that most determines the success or failure of

[24] Kai, Yusniawati, Mahludin Baruwadi, and Wawan K. Tolinggi. "Analisis distribusi dan margin pemasaran usahatani kacang tanah di Kecamatan Pulubala Kabupaten Gorontalo." *AGRINESIA: Jurnal Ilmiah Agribisnis* 1 (2016).

[25] Erjavec, Karmen, and Emil Erjavec. "Framing agricultural policy through the EC's strategies on CAP reforms (1992–2017). *Agricultural and Food Econnomics* 9 (1): 5." (2021).

implementing agricultural digitalization. This factor is Human Resources itself. Most farmers in Indonesia have minimal knowledge about digitalization, it could be said that they are technologically clueless. This is because farmers do not have high education, so they are very unfamiliar with digital technology. Apart from that, most farmers are already old, so it is very difficult to apply technology in agriculture. However, there is nothing wrong if farmers are willing to learn and have a strong will.[26]

In general, this agricultural digitalization and downstream program helps the government's efforts to improve the welfare of Indonesian farmers and realize the country's food sovereignty. Digitalization and downstreaming of agricultural systems is an implementation of President Joko Widodo's direction for agricultural welfare. Apart from making it easier to access all data and harvest possibilities, this digitalization and downstream program in the agricultural sector was created to support the progress and welfare of regional farmers and help stabilize domestic food availability.

Digitalization itself refers to the use of various technologies and digital data with the aim of being effective and efficient in improving existing activity processes. If it is related to agriculture, agricultural digitalization can simply be interpreted as changing the way things are done in all aspects of agriculture, for example from processing to marketing. The change in question is a conceptual changeby using the latest technology related to the industrial era 5.0, so that various activities in the agricultural sector can be carried out more effectively and efficiently.[27] One way of digitizing food production can be realized by developing business models for digital farming, urban farming, and digitizing marketing, including QRIS facilitation for traders. This concept

[26] Singh, Ritambhara, and Mahesh R. Prajapati. "An agribusiness perspective of demonetization in central region of the state of Gujarat in India." *Journal of Economic Structures* 9.1 (2020): 51.

[27] Johan, D., M. S. Maarif, and N. Zulbainarni. "Farmers' Perceptions Of Agricultural Digitalization To Support Farmer Independence." *Jurnal Aplikasi Bisnis Dan Manajemen* 8.1 (2022): 203-216.

will be able to encourage productivity to support price stability and food security.[28]

The application of agricultural digitalization in the agribusiness sector is increasingly in demand, as per research conducted by Johan et.al. has created the E-Tani application which can be a place for farmers to learn, distribute agricultural produce (harvest) and buy agricultural tools and needs, regardless of space and time. This E-tani application is a web-based e-commerce information system that uses the system development method or SDLC (System Development Life Cycle) method.[29] Meanwhile, Abbas and Suhaeti designed post-harvest technology dissemination with the aim of increasing the added value of products, as well as strengthening competitiveness against similar products. Processing agricultural commodities into processed products can increase added value and ability to compete in the market.[30] Ozdogan et al. who explained that digital agriculture has an influence on agricultural productivity and adds economic added value.[31] Arifiani and Wiratmo in their research stated that smartphone applications can be adapted to farming activities, namely by focusing on farmers' needs in production, post-production and as a consultation, as a single unit which ultimately presents utility and economic value for farmers.[32] Likewise with Pinontoan et al, Costopoulou et al, and Qjang et al, said that smartphone applications for agriculture as

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[28] Elizabeth & Anugrah, "Akselerasi hilirisasi produk agroindustri berdayasaing mendongkrak kesejahteraan petani dan ekonomi pedesaan."

[29] Johan, Daniel, M. Syamsul Maarif, and Nimmi Zulbainarni. "Persepsi Petani Terhadap Digitalisasi Pertanian untuk Mendukung Kemandirian Petani." *Jurnal Aplikasi Bisnis dan Manajemen (JABM)* 8.1 (2022): 203-203.

[30] Abbas, Akmadi, and Rita Nur Suhaeti. "Pemanfaatan teknologi pascapanen untuk pengembangan agroindustri perdesaan di Indonesia." *Forum Penelitian Agro Ekonomi*, 34.1 (2016).

[31] Ozdogan, Burak, Anil Gacar, and Huseyin Aktas. "Digital agriculture practices in the context of agriculture 4.0." *Journal of Economics Finance and Accounting* 4.2 (2017): 186-193.

[32] Arifiani, Hauliah. "Aplikasi smartphone sebagai alat penunjang dalam kegiatan bertani." *Visualita* 6.1 (2014): 266955.

a development medium also require identification of farmers' needs in accordance with their farming activities.[33]

The future of Indonesian agriculture is technology-based smart agriculture. It is hoped that farmers will gain an understanding of the required land use, but the results will be satisfactory and the costs will be more efficient. With smart farming, the effectiveness and productivity of farming is more measurable because all farmer activities are based on accurate data analysis. The entry into the era of smart agriculture based on technology integration will make agricultural cultivation more effective so that it will be more accurate in determining the amount of input needed. In fact, less productive idle land is now being used for food crops and horticulture. The Ministry of Agriculture needs to collaborate and take part in implementing smart farming with the Ministry of Villages PDTT. Apart from that, the Ministry of Agriculture needs to be more serious by creating a bigger smart farming roadmap such as the Ministry of Villages PDTT which not only covers several regions but also involves various interested stakeholders. The Ministry of Agriculture's big program, namely Konstra Tani and food estate, will be very helpful in supporting smart farming 4.0 so that Indonesia can achieve food independence.

Meanwhile, downstream activities themselves are the integration of various activities from raw materials to finished or semi-finished or other processed products with new innovations. The downstream system is usually used to develop agroindustry producing food products which is basically aimed at meeting the needs of the community for food products with guaranteed quality and competitive prices, in addition to increasing added value and exports as well as expanding business and work opportunities. Apart from the financial side, the added value obtained from downstream development can also increase labor absorption, increase

[33] Pinontoan, Andreas R., Robert Molenaar, and Hildy Wullur. "Aplikasi Pembelajaran Praktis Alat dan Mesin Pertanian Berbasis Android." *Cocos*, 6.11 (2015); Costopoulou, Constantina, Maria Ntaliani, and Sotiris Karetsos. "Studying Mobile Apps for Agriculture Informatics Laboratory, Department of Agricultural Economics and Development, Agricultural University of Athens, Greece." *IOSR Journal of Mobile Computing & Application (IOSR-JMCA)* (2016): 2394-0050; Qiang, Christine Zhenwei, et al. *Mobile Applications for Agriculture and Rural Development*. Washington DC: World Bank, 2012.

the knowledge and skills of human resources in implementing processing technology.[34]

Accelerating agricultural downstreaming is also defined as efforts, processes and policy programs to reinvigorate multi-purpose agriculture, empower its capabilities, build its competitiveness, improve its performance, and improve the welfare of those involved, especially farmers, as part of efforts to improve the welfare of all people.[35] The acceleration of downstreaming carried out by developing and improving agricultural activities, especially agro-industry to strengthen product processing processes, as well as developing technology in the processing industry sector, will strengthen the bargaining position of various Indonesian agricultural-based processed products, both in regional markets and in world (international) markets. It is also recognized that the downstreaming of the food sector is a strength in supporting economic growth. Apart from commodity downstreaming, Processing and marketing are things that must be improved, so that farmers or MSMEs will be able to produce products that have added value. Moreover, each region has its own advantages.[36]

The implementation and acceleration of development and improvement of downstream agro-industrial activities allows the Indonesian people to escape the trap of the paradox of plenty, namely a condition where a country is rich in natural resources but its people are poor.[37] Downstreaming also has links: consumption, investment and

[34] Elizabeth & Anugrah, "Akselerasi hilirisasi produk agroindustri berdayasaing mendongkrak kesejahteraan petani dan ekonomi pedesaan."

[35] Akudugu, M. A., et al. "Technology adoption behaviors of farmers during crises: What are the key factors to consider?." *Journal of Agriculture and Food Research* 14 (2023): 100694.

[36] Pratiwi, Nandika Aisya, Harianto Harianto, and Arief Daryanto. "Peran Agroindustri Hulu dan Hilir dalam Perekonomian dan Distribusi Pendapatan di Indonesia." *Jurnal Manajemen & Agribisnis* 14.2 (2017): 127-127.

[37] Anyoha, N., et al. "Information and Communication Technology Roles in Improving Women Farmers Access to Agricultural/Agribusiness Services in Orlu Agricultural Zone of Imo State, Nigeria. *Current Investigations in Agriculture and Current Research* 83 (2018).

labor[38], which causes the relocation of resources (HR and capital) between sectors, so that other sectors are sacrificed in the process from primary products to processed products.[39]

Digitalization and downstream can be implemented through digitalization of the upstream and downstream side of production, post-harvest, warehousing, processing, marketing and financing in the food sector through optimizing the role of MSMEs. This is realized by preparing a business model digital farming through distribution smart green house to MSMEs, distribution smart farming to food clusters, distribution of post-harvest processing machines, inauguration of food barns with Rice Milling Unit (RMU) and Bed Dryer, digitizing product marketing with start-up agriculture, to market digitalization including QRIS facilitation for sellers. Second, quick wins short-term food inflation control consisting of market operations and cheap food promotions for strategic food commodities at 277 points throughout Java, expansion of inter-regional cooperation (KAD), distribution efficiency through the provision of logistics services and storage affordable prices to optimize the development and assistance of organic fertilizers.[40]

Designing an agricultural digitalization model can be done by developing existing system. These developments are by integrating upstream subsystems down to downstream subsystem. Where in this development of course farmers can't create their own systems, so it can be considered for work the same as existing platforms for support agricultural marketing in Indonesia. More optimizing the role of extension workers by carrying out them technological guidance to farmers, of course very beneficial for the awareness of related farmers existing technology, especially technology for encouraging the development of agricultural activities digitalization of farmers. In fact, this technological guidance requires the involvement of all parties, one of them is government support.

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[38] Wilkinson, John, and Rudi Rocha. "Agro-industry trends, patterns and development impacts." *Agroindustries for Development.* Wallingford, UK: CABI for FAO and UNIDO (2009): 46-91.

[39] Elizabeth & Anugrah, "Akselerasi hilirisasi produk agroindustri berdayasaing mendongkrak kesejahteraan petani dan ekonomi pedesaan."

[40] Marcu, Ioana, et al. "Arrowhead technology for digitalization and automation solution: Smart cities and smart agriculture." *Sensors* 20.5 (2020): 1464.

Implementation of agricultural digitalization can be done by pay attention to the existing agricultural conditions including village conditions, technology used, farmer characteristics, companion role, perception farmers and system requirements. With this system agricultural digitalization is expected to increase agricultural performance starting from upstream subsystems to downstream subsystem.[41]

In order to ensure the success of sustainable agricultural development programs through digitalization and downstreaming to strengthen national food security, executive and legislative policy support at the provincial and district/city levels is urgently needed.[42] Government policies which are generally biased towards physical investment and capital will be more beneficial if they are aligned with the development of rural institutions which are synonymous with agricultural development, so that they are expected to be able to accommodate development based on agricultural products. The digitalization and downstream system of agricultural commodities is directed at realizing a competitive, fair and sustainable industrial agricultural system in order to guarantee food security and the welfare of agricultural communities. This requires several other related policies support, namely:

a. Development of agricultural infrastructure, including construction and rehabilitation of irrigation networks, expansion of agricultural land, especially outside Java, prevention of land conversion, especially in Java, development of farming roads and production roads and other infrastructure;
b. Financing policies to develop financial institutions that specifically serve the agricultural sector, microfinance institutions, sharia pattern financing, and others;
c. Conducive macroeconomic policies, namely low inflation, stable exchange rates and positive real interest rates;
d. Trade policies that facilitate smooth marketing, both in the domestic and export markets;

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[41] Ilyas, Ilyas. "Optimalisasi peran petani milenial dan digitalisasi pertanian dalam pengembangan pertanian di Indonesia." *Forum Ekonomi: Jurnal Ekonomi, Manajemen dan Akuntansi*, 24.2 (2022).

[42] Rajak, Prem, et al. "Internet of Things and smart sensors in agriculture: Scopes and challenges." *Journal of Agriculture and Food Research* 14 (2023): 100776.

e. Industrial development policies that place more emphasis on small-scale agroindustry in rural areas in order to increase added value and farmer income;
f. Conducive investment policies to further encourage investor interest in the agricultural sector;
g. Development financing that prioritizes the budget for the agricultural sector and its supporting sectors; and
h. Regional government attention to agricultural development includes: agricultural infrastructure, empowering agricultural extension workers, developing agricultural agencies, eliminating various levies that reduce agricultural competitiveness, as well as adequate APBD allocation.[43]

Conclusion

In conclusion, the global economic landscape is witnessing fluctuations exacerbated by The Perfect Storm, which heightens the risk of stagflation and recession across various nations. These global dynamics inevitably impact Indonesia's national economy, necessitating strengthened efforts and calculated measures to bolster the performance of various economic sectors. Understanding Indonesia's role within the global economic and political constellation is paramount to guaranteeing successful national economic recovery endeavors, while concurrently ensuring food and energy security. Between 2018 and 2022, Indonesia's food security index, based on GFSI, experienced a decline in ranking from 58th to 63rd, with a corresponding decrease in the food security index score from 63.6 to 60.2. This downgrade in ranking in 2022 was primarily attributed to a decrease in food quality and safety scores, exacerbated by the Russian-Ukrainian war-induced increase in food prices and political barriers, impacting food availability.

To address these challenges, the Indonesian government has favored programs such as Digitalization and Downstreaming of agriculture. These novel concepts hold promise for further developing Indonesian agriculture, offering farmers insights into optimal land use, cost efficiency,

[43] Elizabeth & Anugrah, "Akselerasi hilirisasi produk agroindustri berdayasaing mendongkrak kesejahteraan petani dan ekonomi pedesaan."

and enhanced productivity. By embracing smart farming practices facilitated by technology integration, agricultural cultivation becomes more effective and precise in determining input requirements. Digitalization and downstreaming initiatives encompass various aspects of agricultural production, post-harvest processing, warehousing, marketing, and financing, optimizing the role of MSMEs. Business models such as distribution of smart greenhouses to MSMEs, smart farming to food clusters, and digitized product marketing through agricultural startups exemplify the strides towards a more resilient and harmonious global ecosystem.

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